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Topic (ii): Streamlining statistical production

# Migration from Legacy Systems

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## I.      Introduction

1.      Statistics NZ relies on technology to deliver its statistics. A major threat to the continued supply of core statistics is Statistics NZ's aging IT technology and processes. Ongoing committed investment is required to ensure our technology environment remains responsive, relevant, and a foundation to a sustainable organization. Statistics NZ has over the years evolved a very complex technology environment with over 250 separate statistical production systems supporting around 80 core statistical outputs. To assure business continuity it was urgent to systematically replace and update outdated technology.

2.      In 2009 Statistics NZ established Legacy Mitigation programme with a purpose to consolidate the number of technologies within the operating environment, migrate to newer supported technology, and retire out-dated systems. This work is now part of Stats 2020 – Te Kāpehu Whetū programme which has been established to rebuild and transform our systems and processes. Paper will provide real examples showing approach, progress to date and lessons learned during the first four years of the implementation of the Legacy Mitigation work.

## II.     Legacy application environment

### A.      What is a Legacy System?

3.      A computer system or application program built on what has since become obsolete technology.  It continues to be used due to the cost of replacing or redesigning it and often despite its poor competitiveness, inability to meet changing business needs and incompatibility with modern equivalents. The implication is that the system is large, monolithic, and difficult to modify, integrate and support. In our case Legacy System definition also includes current technologies which don't fit Enterprise Architecture standards for statistical outputs (see Figure 1).

Figure 1: Technologies 'out of Enterprise Architecture standards for statistical outputs
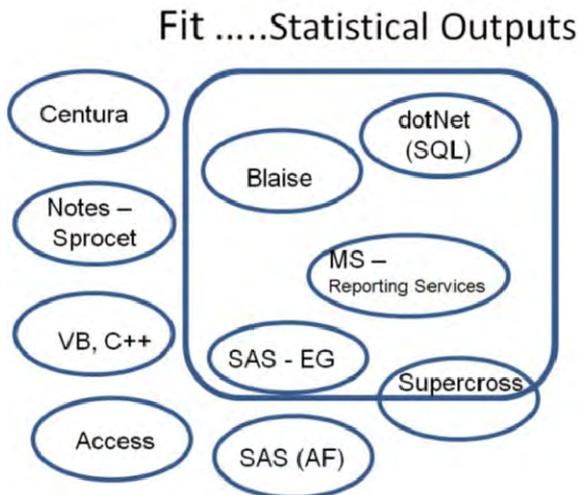


## B.      Origin of legacy and early mitigation

4.      Through 1999 - 2004, as the organisation took advantage of the Client-Server environment and the wider availability of software tools, a wider number of underlying tools were being used to build statistical applications. Even by 2001, the main development language Centura, was becoming a cul-de-sac tool and applications began being developed in Visual Basic and Microsoft Access. Also during this time Lotus Notes was being deployed and used in increasingly complex ways with a full-scale statistical processing template for a number of business surveys under the name SProceT. And in the dissemination / table outputs area, the twin products of SuperStar and SuperCross were gaining popularity, as these tools were heavily exploited for Census production. Throughout this period, SAS remained as a pivotal end-user tool and the move from mainframe versions of SAS to PC SAS (V8) was being adopted with vigour, with users taking advantage of new (for the time) techniques such as DDE (Dynamic Data Exchange - enabling transfer of SAS datasets to Excel) and the SAS/AF user interface tools.

5.      From 2003, the new IT Strategy set the stage for the adoption of Microsoft technologies for both our main applications development language (C# .Net) and data storage (SQL-Server). These recommendations were, in part, to address the risks that our underlying technologies were becoming obsolete. The Centura, Sybase foundations laid in 1994-96, when Statistics NZ moved from a Mainframe to a Client-Server environment were no longer suited to the wider aims of the organisation, in particular the building of a standardised statistical processing environment through what became known as the Business model Transformation Strategy (BmTS).

6.      The objectives of the BmTS, were to, over a 9 year period (2004 - 2013) transform Statistics NZ's processing and statistical production environment based on standardising processes, methods and systems. The 'platform' had three key deliverables:
    (a)      A number of standard, generic end-to-end processes for collection, analysis and dissemination;
    (b)      A disciplined approach to data management, using a standard information life cycle;
    (c)      An agreed, enterprise-wide technical architecture which would build up "over time a portfolio of standard solutions and components".

7.      The first three years of the Strategy (2004 - 2007) were to "Set the strategic direction"; to build prototype platforms and complete the overall architectural designs for standardisation. The second stage (2007 - 2010) were for "Delivering the first end-to-end solutions" and the third stage  (2011 - 2013) "Migration of systems into the BmTS", this was when remaining applications / statistical outputs would be migrated  to the new technology and business process environment.

8.      At the end of Stage 1 a full review of the BmTS was undertaken. The BmTS Review presented in December 2007 noted that while the principles remained sound and that the fundamentals of the platform (from a technological perspective) had been proven, support had become disparate, deliveries were behind schedule and there were gaps in understanding of what had been delivered. There were also significant resourcing, capacity and capability gaps.

9.      In March 2008 the Statistics NZ Executive Board reaffirmed the objectives and principles of the BmTS but recognised that a different approach was required. This new approach included:

   (a)      That the next two years (2008 - 2010) focus on the preparation of a robust Investment Case, for separate funding of the BmTS development;
   (b)      Focus will continue on standardising processes or methods, using technology as an enabler only when the value is proven;
   (c)      While there will be no further direct software development of BmTS Components, projects will still be encouraged to adopt proven deliveries, and a team will work to ensure that the wider organisation is made aware of these deliverables, and will continue to drive the behavioural changes required to keep the organisation moving.

It has been also noted that "the longer there are delays in delivering IT Systems within the BmTS, the more the organisation will need to invest in updating, maintaining and supporting current (legacy) systems".

## III.    Legacy mitigation approach

*"The Legacy problem is like global warming.  Some people don't believe there's a problem at all but the ones who do know that it won't go away by itself, it will only get worse"  Matjaz Jug - September 2008*

### A.      Situation in 2008

10.      Initial analysis estimated that Statistics NZ has approx. 200 business critical applications which are in obsolete technologies. Additionally, there are approx. 100 'end user' written/supported business critical applications all based on legacy technologies. Most of our high profile statistical outputs (CPI, BoP, GDP, HLFS and Vitals) rely on legacy technologies. They rely on IT skillsets that are very difficult to source and they are also equally difficult to build internally, as these skills are not marketable. We are reliant, for example, on just five IT staff to support Centura based applications. Centura is a language that is no longer taught and it is not easily 'picked up' and unfortunately we have at least 30 business critical applications using it, including those used for our CPI and Overseas Trade statistics.

11.      It was additionally noted that the exposure to our legacy environment is compounded by the number of legacy end user developed applications and data sets, predominately in SAS and Microsoft Access.  From a scan of IT environment it was estimated that there were 500,000 legacy SAS datasets on shared drives, PC drives and the SAS 8 server, hence not only a legacy issue but a potentially serious data management issue. At the time there was no estimate of the number of SAS/Access/Excel programmes within the end user environment that contributed to a published statistical output.

Figure 2: Use of obsolete and inappropriate technologies in production of high priority statistical outputs

| Statistical Output Priority V5 | Centura | VB | Access | Sprocet | Super* | SAS (AF) to verify | Excel / Word |
|---|---|---|---|---|---|---|---|
| QGDP | | | ■ | | | ■ | ■ |
| RTS (M) | ■ | | ■ | | | ■ | ■ |
| Overseas Trade | ■ | | ■ | | ■ | | ■ |
| Prices | ■ | | | | ■ | | ■ |
| (Un)Employment (HLFS) | ■ | | | | ■ | | |
| IIP | | | | | | | |
| Balance of Payments | ■ | | | | | | |
| RGNDI | | | | | | | |
| Annual BoP | ■ | | | | | ■ | |
| Annual National Accounts | | | ■ | | | | |
| Annual IIS | | | ■ | | | | |
| Population Census - Core topics | | | ■ | | ■ | ■ | ■ |
| Population Estimates | | | | | | | ■ |
| AES | ■ | | | ■ | | ■ | |
| RTS (Q) | ■ | | | ■ | ■ | | |
| WTS | | | ■ | | | | |
| QIIS | | | ■ | | | | |
| QES | ■ | | ■ | | | | |
| OTI | ■ | | ■ | | | | |
| HES | ■ | | | | ■ | | |
| PPI | | | | | | | |
| QBAS / Building Consents | ■ | | ■ | | ■ | | |
| CGPI | | | | | | | |
| LEED (A) | | | ■ | | | ■ | |
| QMS | | | | ■ | | | |
| AIIS | | | | | | | |
| Agriculture Prod | ■ | | | ■ | | | |
| NZIS | | | | | | | |
| Business Frames (BFUS / MFUS) | ■ | | | | ■ | | |
| ITSS | | | | | | | |
| ICT (HH and Business) | | | ■ | | | ■ | |
| Local & Central Govt. Accounts | | ■ | | | | | |
| PES (Census) | | | | | | | |
| Migration Statistics | | | | | ■ | ■ | ■ |
| Vitals (Births, Deaths, Marriages, Divorces) | | ■ | | | | | |

## B. Approach

12.     With the hiatus of the BmTS a Situational Analysis Paper was presented to the IT Advisory Group in October 2008 which outlined options for dealing with legacy systems:
    (a)     Take no specific action and rely on obtaining funding to provide a migratory environment;
    (b)     'Migrate All';
    (c)     'Redevelop All';
    (d)     Undertake a phased, multifaceted approach to resolution.

13     Until February 2008 the default mitigation strategy for the legacy environment has been the expectation of the delivery of the BmTS platform which would then provide platform on which to migrate 80% of these legacy applications. However, with the cessation of the development of that platform and the reliance on the government business case bid process it was unlikely that any platform will be available until at least 2011/2012. The first option was no longer a sustainable solution as it wold extend the risk exposure of the organisation beyond the acceptable level, if we continue to leave the legacy system issue unresolved.

14     Replacement of our entire legacy environment through a concerted migration effort would remove all risk associated with the legacy environment.  The 'Migrate all' option would see an organisation wide resource commitment reminiscent of the 1990's mainframe migration and Year 2000 (Y2K) programme. The resources required for this option would effectively halt the ability of Statistics NZ to undertake any other significant improvement or innovation based projects.

15     The resource commitment for third option 'Redevelop All[1]' would not only absorb all available IT resources but also require significant resource investment by all areas of the organisation. The other business areas would be both participating in the redevelopment and also articulating what it would take to bring the applications up to a point where they were once again meeting organisational needs. It was unlikely that

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[1] Option 'Redevelop all' would involve transformation of business processes as opposed to 'Migrate all' which was seen as a 'AS IS' migration.

Statistics NZ would be able to commit to such an extensive use of resources both money and people (even if it had them) so both option 2 and 3 were discounted.

Figure 3: Phased, multifaceted approach to legacy systems transformation
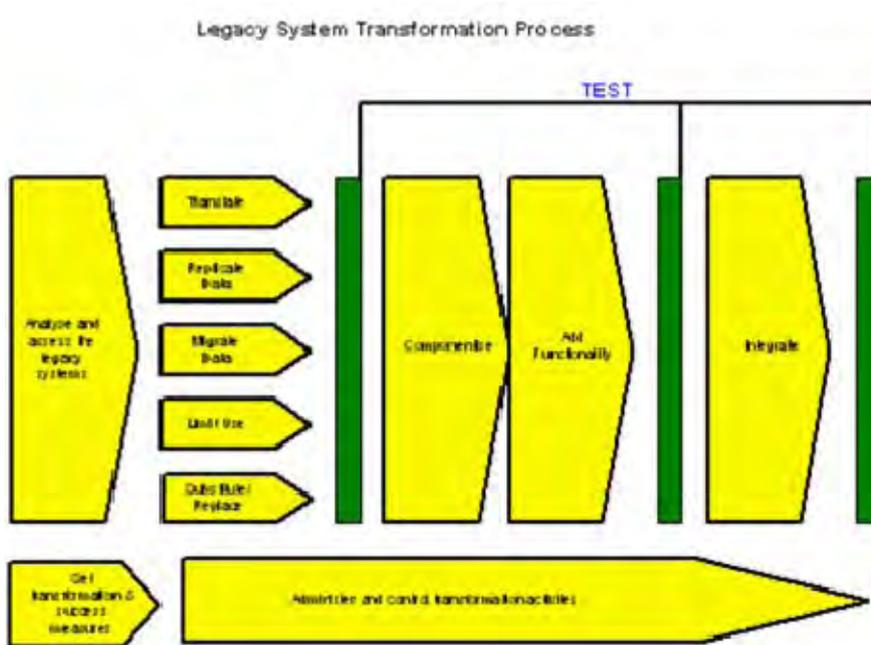


16     The paper recommended that a "phased, multifaceted approach" was required to address the legacy software issues, as this best suits the corporate model and way of working and can ensure that solutions are adopted that best fit the situation (the technology, the application, the statistical priority and the integration and standardisation needs). The March 2009 Legacy Mitigation Roadmap outlined in detail what the "phased, multifaceted approach would comprise and the anticipated timeline. It set the target date of March 2016 for the achievement of removal of all legacy systems.

17     The following table briefly describes the terminology used within the proposed model:

| | |
|---|---|
| **Translate** | Using software and external expertise to translate the existing code base into the selected updated technology, in our case C#.net. Off-shore service translation engine has been first used on our Prices system GIFT (the Centura based front end). This option enables direct translation without change of functionality. |
| **Replicate Data** | Sybase replication enables a copy of the database and database elements to be hosted in SQL Server (our corporate database management system), permitting new functionality to be built on the SQL Server version whilst the old Centura front end can retain its interaction as if the data was held in Sybase. |
| **Migrate Data** | Migrate data held in non SQL Server databases (for example Sybase, Access) and deliver new 'front end' functionality. |
| **Limit Use** | 'Wrap' (isolate implementation) the entire solution and provide an interface layer. The current functionality can be utilised but **no** enhancements can be made within the isolated legacy system[2]. |
| **Substitute/ Replace** | Where there is a business decision to redevelop one or more legacy systems this is the appropriate mechanism to use. Where there are no other options we must substitute or replace (which may then involve redevelopment) the functionality provided by the legacy system with a modern technology alternative. |
| | |
| **Componentise** | Breaking up large monolithic legacy systems into component parts and reviewing each component part for the opportunity to apply any of translate, replicate, migrate, limit use or substitute/replace options at the component rather than system level. |
| **Add functionality** | To enable integration additional functionality may be required. |
| | |
| **Integrate** | Integrate the migrated system (or components) into the current environment. |

[2] This approach has been later implemented and is called "museum"

## C.  IT Strategy 2009-12

18      Resolving system legacy problem has become a major priority in IT Strategy 2009-12 with the following objective: "Statistics NZ's IT infrastructure is sustainable and robust with standardised platforms based on the generic Business Process Model (gBPM) and aligned with statistical architecture (clusters). Stove-pipe, legacy IT applications will be a thing of the past."

19      The Legacy mitigation approach provided us with the opportunity to review the options, the phasing and the undertaking of additional work whilst ensuring we progress in a sustainable way. It has enabled us to do the most important thing: change the trend from continual increase in the number of applications (legacy and total) and greater complexity of the overall enterprise architecture to a decrease in a managed, step-wise way, in both total numbers and complexity, hence mitigating the risks to the organisation.

20      The combination of these activities and viewing the gBPM[3] from a business capabilities perspective has resulted in an Enterprise Architecture approach which we have termed the 'platform approach'. Five platforms have been initially identified, and are in various stages of implementation; the Platform for Household statistics, the Platform for micro-economic statistics, the National Accounts Platform, the Collection Platform and the Dissemination Platform. This approach has enabled the mitigation of a number of the risks associated with implementation and has provided Statistics NZ with a sound basis on which to progress Enterprise Architecture.

Figure 4: Platform-based Enterprise Architecture model



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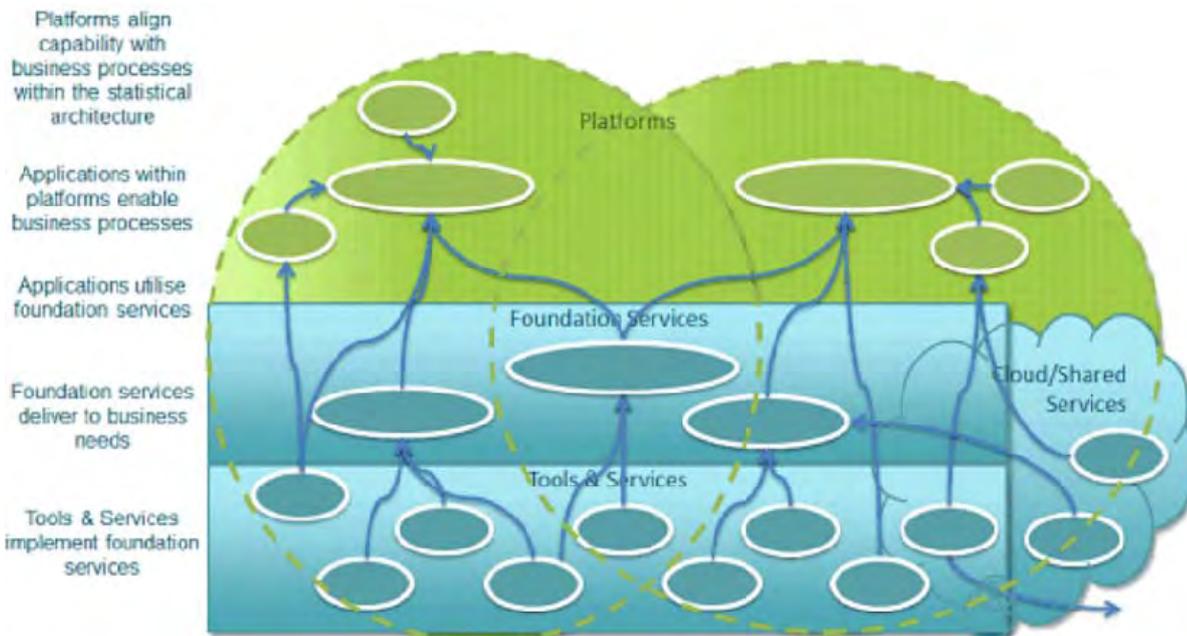
[3] Generic Business Process Model has served as a basis for international Generic Statistical Business Process Model

## D.    Early lessons

21      An internal review after the first year of the programme found that the multifaceted mitigation approach remains sound. Learning in the first year pointed to the work ahead being more complex and intertwined showing that legacy is not just a technology issue, and has almost been a state of mind. Resolving legacy issues requires a more holistic approach:

(a)     The Roadmap to remove our legacy issues focusses on the specific actions being undertaken within the Legacy Mitigation funded work as part of the IT Investment Programme, however this is only a part of what is being and what needs to be done to resolve legacy issues. Legacy mitigation does not solely depend upon projects within the Legacy Roadmap, but also relies on the success of business unit led redevelopments, ongoing software upgrades and integration with new infrastructure (Platforms) being built. This activity needs to be cognisant of the timeline set by the Mitigation Roadmap. The Shutdown date has been extended to take some pressure off, but re-development delivery delays beyond June 2013 will cause existing applications to be operated from the "museum"[4];

(b)     Many statistical outputs rely on a complex mix of legacy technologies. While there remains value in undertaking a technology-specific approach, understanding the end-to-end process and inter-relationships of these applications will be important in arriving at the most appropriate legacy mitigation solution. Undertaking Process Analysis for key outputs will be a required step in the evaluation path;

(c)     Standardisation and the delivery of Platforms provide the basis for an integrated future, however legacy mitigation work being undertaken in parallel with the building of these Platforms can add to the complexity in delivering the solution. There is need to balance the desire to achieve the end-goal of standardisation with the urgency of removing legacy software;

(d)     Implementing a more holistic, integrated approach requires stronger alignment and cross-management with long-term planning, such as the long-term assets management plan (LTAMP), and Investment Case. These corporate and long-term planning tools can work alongside the Legacy Roadmap to ensure that the right projects are being undertaken for the right reasons at the right time. This requires a higher level of overview than has occurred in the first year;

(e)     Legacy software is an indicator of legacy documentation and practices. Whatever replacement path is chosen, the deliverables at the end will  not only include an application which is consistent with Statistics NZ supported technology environment, but also will need to include up-to-date documentation (both user and technical) and a full set of test cases for that application. The costs of replacement need to include not only the IT effort, but the business areas efforts in preparing for and the testing of the replacement;

(f)     In bringing legacy applications up-to-date recognition of current standards and procedures needs to be taken into account. Where standard tools or platforms exist then the replaced application should (ideally) be adopting these;

(g)     Upgrading technologies also involves training to take advantage of the new features of the new version. Often the training element has not been fully provided for in the past, this can leave gaps in skills or busy staff relying on the known tried and true ways. This can and has had implications when software makes a significant step-up. Our legacy SAS environment is predominately PC based and used for processing. While good efforts have been made in the last year to improve SAS EG training, without changing the underlying ways in which we use we cannot realise its full potential;

(h)     Meanwhile, we must also mitigate the risk of losing key staff who have the expertise in our legacy software and applications. These people often hold the keys which unlock an understanding of the application's functionality (and quirks) which is vital knowledge during the replacement process. These skills and their level of expertise will still be needed when we have replaced the legacy systems.

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[4] Museum refers to the stand alone and untouched environment able to run older technology for a limited period

## IV.    Statistics 2020 – Te Kāpehu Whetū

### A.    IT Risk Review

22.    Through 2009-2010 - as the Legacy Roadmap was being developed, the wider transformation of Statistics NZ was being planned. The Programme to be known as Statistics 2020 - Te Kāpehu Whetū was developed alongside the Legacy Programme - indeed becoming a key foundation / planning assumption. An essential part of the 2020 objective was to introduce "sustainability" (keeping the organisation responsive and "fit"). As part of planning the Stats 2020 Business Case the Legacy Programme (and proposed Enterprise Architecture) were externally reviewed.

23    The IT Risk Review report described the Statistics NZ environment as a "ticking time-bomb" and noted "that risks associated with people and capability will become urgent and put outputs at risk within the next five years, if left unchecked. The complex nature of the environment, the legacy technologies employed and the gap between the current architecture and the desired future architecture mean it will take a concerted programme of effort over approximately a five-year period to fully mitigate these risks." Overall these findings were seen as an endorsement of the approaches being taken and underlined the urgency of the transformational and standardisation aspects of the Statistics 2020 Business Case.

24    Following the risk assessment, Horizon Consulting was asked to examine Legacy Mitigation planning and the Statistics NZ Enterprise Architecture in more detail. The brief was to assess the suitability of the approaches being taken, the level of risk in these approaches and to suggest other options where appropriate. Overall the findings were very positive, with only a limited range of alternative planning options to consider. In summary the detailed assessment found:
  (a)    The challenges that Statistics New Zealand faces of migrating legacy technologies and moving to a well ordered Enterprise Architecture are significant. They are a result of organic growth from independent silos over many years that have led to an IT environment that is not sustainable.
  (b)    That Statistics New Zealand is proceeding with both its Legacy Migration and Enterprise Architecture development in a prudent, well thought out and reasonable manner;
  (c)    Recommended that the Museum be introduced earlier.
This recommendation was implemented in the 2011/12 Legacy Charter and Business Case provision to implement the Museum and test the concepts. This was also seen as a safety net measure should any issues arise with the Windows 7 upgrade.

Figure 5: Development stages of Statistics 2020 (From Statistics New Zealand Statement of Intent 2011–14)

Figure 6: Current timelines for Legacy Roadmap programme
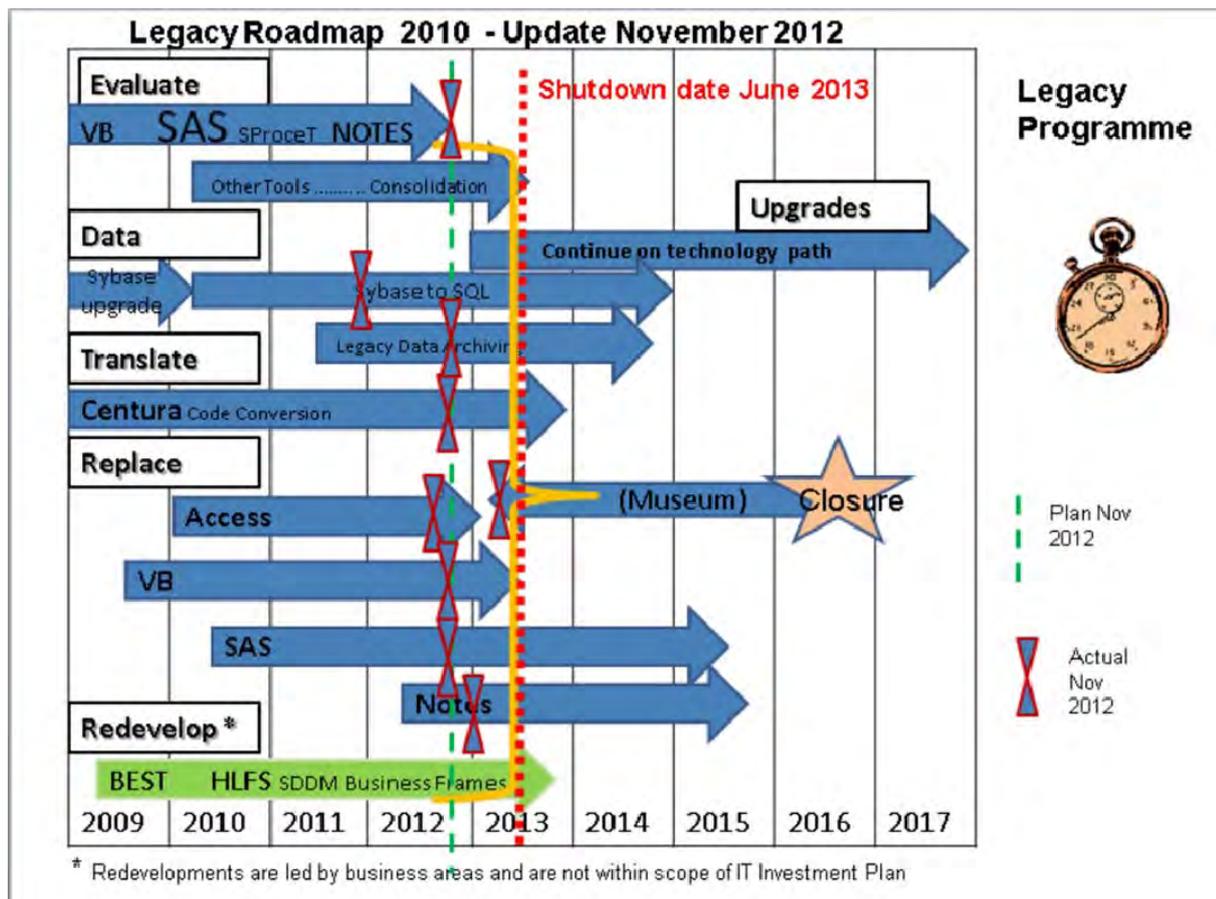


## B. Progress and achievements

25. Figure above presents current Legacy Mitigation Roadmap. While time wise we are approximately half-way through the programme there have already been significant achievements:

    (a) **Evaluate Stream** (full discovery of all legacy software): all major systems have completed evaluation, with the remaining (low order) tools scheduled for evaluation over the next twelve months;

    (b) **Data Stream** (the migration of legacy data to the standard Enterprise environment): the Sybase upgrade was completed in 2010, and work continues on the migration to SQL. However the effort in migrating the Sybase programs to SQL has been found to be far greater than originally estimated. We have broken this project up into a number of stages to allow flexibility as we merge with other business led redevelopments. Data archiving continues on schedule, allowing a smooth transition from the production environment to managed storage and archiving where required;

    (c) **Translation stream** (direct translation of Centura code to C#.net for suitable applications): our highest priority systems (Prices, Balance of Payments and their associated survey management applications) have been completed, and work is now underway on the tier 2 systems;

    (d) **Replacement Streams** (redevelopment of 'like for like' systems in current technology): out of the original 5000+ MS Access systems in scope, the last 5 due for redevelopment are underway and scheduled to complete by end 2013. The last 2 Visual Basic systems in scope for replacement in the Legacy program (out of the 15) are now underway. The last 2 SAS AF applications (out of 16) are under redevelopment. Over 99% of the SAS DDE programs have been mitigated. The first of the Lotus Notes Applications are being refreshed this year.

Figure 7: Legacy programme completion across technology streams (note: the last 5 - 10% in each stream requires significant effort - they tend to be the most complex systems to replace)



**Legacy Programme - Completion based on Quantity**

(March 2013)
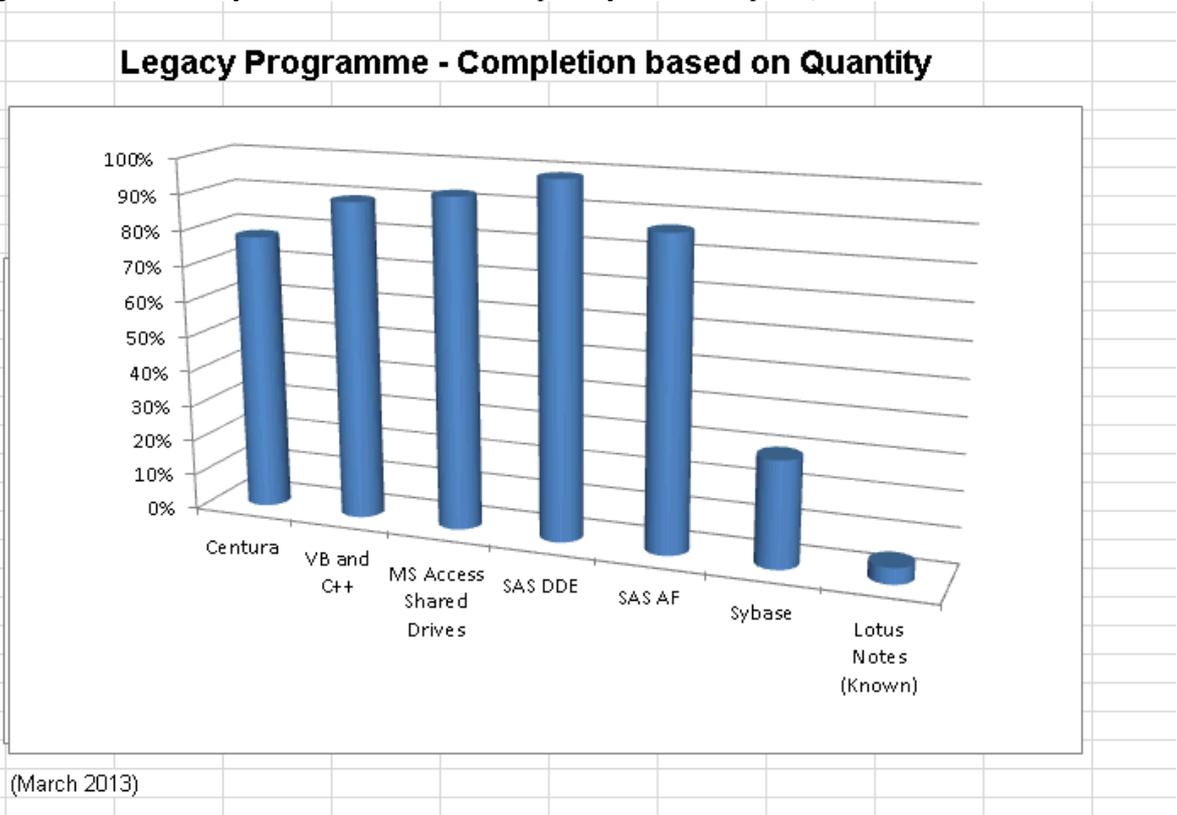
(e)    **Redevelopment Stream** (business led redevelopment of legacy systems providing significant functional improvements): there are a number of redevelopments (part of Statistics 2020) that are mitigating Legacy issues. These are continuing apace, and the Legacy Programme maintains a monitoring role to ensure timelines and scope remain within the Legacy Roadmap time frames and parameters.

## C.    Lessons learned

26    Finding out what we have and what is still in use. While the information regarding IT supported systems tends to be organised and fairly easy to access, information as to the detailed content of older, less 'volatile' systems (ie don't require ongoing maintenance) tends to dilute over time, with upgrades of information systems etc transferring less and less detail. The availability of experienced staff who developed and support these systems also reduce over time. The end result is that we now:
    (a)    Expect to uncover issues as we look into these older systems;
    (b)    Expect to have to continually replan as new items come to light;

27    The real challenge is identifying what we have in the End User Computing (EUC) environment. Our Roadmap calls for removal of all MS Access systems, and the migration to SAS EG, which means removal of all programs containing Dynamic Data Exchange (DDE). Both of these are typical End User Computing areas (we identified over 5,000 MS Access systems, and over 10,000 SAS programs that needed to be addressed). As expected, in the EUC space, nothing ever gets deleted or retired. New systems replace old, but the old remain. Business developers move around, they come and go. We addressed this problem by:
    (c)    Never assuming a single source of complete information. We combined technical scans, business surveys and technical staff surveys to get a better picture;
    (d)    Adopting a highly iterative approach over several years to reduce the size of the problem. We 'drained the swamp' by repeating our surveying at quarterly intervals;

(e)     Working closely with Information Management team who are responsible for data archiving. Business units are more likely to release old systems if they know they are subject to rigorous archiving processes;

(f)     In tandem with removing old software, we established from the outset a number of redevelopment teams to tackle the systems we knew were still required.

28      From the business perspective, the Legacy programme doesn't provide any extra functionality. Yet the business units need to provide sometimes significant resource to assist in test case preparation and testing. The level of communication as to what the Programme is aiming to achieve and is achieving needs to be presented from and to all levels of management and staff. Success stories are particularly important to be published, so as to maintain visibility and to emphasise progress:

(g)     Importance of Communications - and use of Intranet to keep the message alive (success stories);

(h)     Testing (especially the translated code) - recognition this needs specialised / dedicated staff (not as a side job);

The Legacy programme funds business units to allow them to 'back-fill' where their staff is required to spend time in the testing process.

# V.     Staying on the roadmap while transforming environment

## A.     Statistics New Zealand IT Strategy 2012-16

29      Ultimate removal of Legacy systems by 2016 is now important milestone in the new IT Strategy 2012-16. Our focus has been extending from addressing risks to realising opportunities, and creating an agile, responsive, and sustainable IT environment. Emerging changes in environment, for example consumer-based mobile technologies, engagement and collaboration using social networks, new methods and tools for storing and analysing massive volumes of data and possibilities to offer and consume services using Cloud-based delivery model and emerging cyber security risks, are reinforcing our need and determination to finally retire 20st Century legacy technologies.

## B.     Future plans

30      Mitigation activities for current legacy systems aren't enough – any technology can and will become legacy so we have to prevent to get into the same situation again:

(a)     Statistics NZ continues to follow the IT Investment Plan to keep us on a sustainable technology path which is aligned with business priorities and the Long Term Asset Management Plan (LTAMP). The IT Investment Plan has a 10-year span and is reviewed annually;

(b)     Ongoing support of production systems includes improved documentation, integration and testing capabilities. Improved deployment processes and ongoing training will ensure ongoing relevance of support and underlying systems and processes;

(c)     As new standardised deployments are made, based on the Enterprise Architecture, and software upgrades and consolidation is progressed, reliance on single-points of expertise will lessen;

(d)     We will continue to participate in New Zealand government standardisation (shared services) initiatives, as well as contribute to wider national statistics office collaboration opportunities. These initiatives ensure that our technology solutions remain consistent with national and international practices.

31      In summary, the Legacy issues could only be addressed within the required timeframe by continual discovery, multiple mitigation streams and coordination with business redevelopment projects. The overall impression of progress is more like a tsunami, where everything moves forward simultaneously - there are no clear cut endpoints in the projects until every item has been addressed. Our experience with Legacy mitigation programme is therefore providing valuable learning which we can apply to any future complex change programme.

32      The Legacy Mitigation Programme is well underway and scheduled for completion in 2016. This programme supports suitable reuse and consolidation, and simplifies (reduces complexity within) our IT environment. Looking to 2017, we have no legacy system issues, and our 'current' systems are resilient and agile, allowing us to easily add, stop or change outputs.

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